Exercise	1	2	3	Total
100%	6	6	6	18
Points				

Extragalactic Astronomy and Cosmology

Homework 6 - Lecture 14 - single component Universe

Due date: October 24

1 Distant galaxy

In a flat Universe with $H_0 = 70\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$, you observe a galaxy at a redshift $z = 6$. What is the current proper distance to the galaxy, $d_p(t_0)$, if the Univserse contains only radiation? What is $d_p(t_0)$ if the Universe contains only matter? What is $d_p(t_0)$ if the Universe contains only a cosmological constant? What was the proper distance at the time the light was emitted, $d_p(t_e)$, if the Universe contains only radiation? What was $d_p(t_e)$ if the Universe contains only matter? What was $d_p(t_e)$ if the Universe contains only a cosmological constant?

2 Horizon in the early Universe

Calculate the horizon distance d_H for an electron when the Universe was only 1000 years old. Assume a flat radiation dominated Universe.

Calculate the number of photons within an electron's horizon (place the electron at the center of a sphere with radius d_H) and determine the total number of photons within that sphere.

3 Redshift in a single component Universe

A light source in a flat, single-component Universe has a redshift z when observed at a time t_0. Show that the observed redshift changes at a rate

$$\frac{dz}{dt_0} = H_0\,(1+z) \;-\; H_0\,(1+z)^{3(1+w)/2} \tag{1}$$

For what values of w does the redshift decrease/increase with time?

Hint: See Ryden Section 5.3